

Undergraduate Research Experience in Ocean/Marine Science (URE-OMS) with African Student Component

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LONG-TERM GOALS

The Undergraduate Research Experience in Ocean/Marine Science program supports active participation by underrepresented undergraduate students in remote sensing and Ocean/Marine Science research training activities. The program is based on a model for undergraduate research programs supported by the National Science Foundation. The URE project features mentors, research projects, and professional development opportunities. It is the long-term goal of the URE in Ocean/Marine Science to provide an active research experience as an effective way to attract talented undergraduates and retain them in careers in ocean and marine science. In addition, this program supports the involvement of students from the African Countries of Ghana, Senegal and Nigeria.

OBJECTIVES

The program objectives are designed to promote the professional development of underrepresented undergraduate students through their participation in ongoing ocean and marine science research. Research team investigations included:

- *Temporal and Spatial Variations of Sea Surface Temperature and Chlorophyll a in Coastal Waters of North Carolina*
- *Younger Dryas Impact Study*
- *The Modeling of Beach Erosion and Shoreline Changes Supported by Prior Research Based on Video Image Processing in Duck, North Carolina*
- *Designing and Developing a Portal for the Polar Grid High Performance Computing System at ECSU.*

APPROACH

Both a flier announcing the program and a webpage were developed to recruit students. Particular attention was paid to recruiting students from minority serving institutions with limited research capabilities. This structure of recruitment will be continued to ensure that while not being exclusive, the program will reach a large number of underrepresented students.

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Producing data and providing technical support for the URE program is the Center of Excellence in Remote Sensing Education and Research (CERSER). CERSER was developed under ONR grant #N0014-1-1070. The CERSER Lab currently consists of the following: 1) TeraScan HRPT system with a polar orbiting tracking 1.5m antenna, 2) Global Positioning System (GPS) Antenna/Receiver, 3) Laboratory consisting of fifteen computer workstations running Linux, Windows 2000, and Windows XP, 4) Remote storage areas of research information, and 5) Servers including a local web server, file server, and an online course server. The CERSER lab will aid in insuring that students engage in innovative remote sensing projects that increase knowledge and understanding of coastal, ocean, and polar science research.

The Program Timeline was as follows:

- Spring: Development of the website and fliers to advertise the program and selection of participants.
- Summer: Conduct training in Ocean and Marine Science, visiting lectures, enrichment activities; Final oral and written reports.
- Following AY: On-line mentoring of students by faculty and advisement of students on applying for future ocean and marine science internships.

WORK COMPLETED

The URE program featured high quality interactions with faculty and/or other research mentors, structured research projects, and professional development opportunities.

- Professional development opportunities:
- Water Quality Analysis
- Boating Safety Certification by the Coast Guard
- GIS Training
- CPR and First Aid Training
- Canoeing in the Great Dismal Swamp
- Field Research Facility at Duck, NC
- Distinguished Lecture - Mohan Munasinghe, 2007 Nobel Peace Prize Co-Winner
- 2008 IGARSS Conference, Boston, Mass

Abstracts from four of the research teams are included below. All team web pages are available at <http://nia.ecsu.edu/ureomps2008/>.

The closing program activities included a distinguished lecture featuring Dr. Mohan Munasinghe, 2007 Nobel Peace Prize co-winner in Global Warming. He is also the Vice Chairman of the United Nations Intergovernmental Panel on Climate Change (IPCC).

RESULTS

Temporal and Spatial Variations of Sea Surface Temperature and Chlorophyll a in Coastal Waters of North Carolina [1]

Temperature and chlorophyll a are two fundamental properties of seawater. Traditionally, both temperature and chlorophyll a are determined by shipboard sensors that can only provide limited temporal and spatial coverage. Consequently, the distribution of temperature and chlorophyll a in

coastal waters of North Carolina is a poorly known. In this study, satellite remote sensing will be used to study the temporal and spatial variations of the coastal waters of North Carolina. The region (34N, 40N, 78W, 74W) of our study will include Chesapeake Bay, Albemarle Sound, and part of Northeast North Atlantic Ocean. Two sets of data, sea surface chlorophyll a (chl a) and sea surface temperature (SST) will be used for this study. Monthly sea surface chl a concentration based on 10 years of Sea-viewing Wide Field-of-view Sensor (SeaWiFS) data and SST data based on 5 years of Aqua-MODIS data will be obtained from NASA website (GIOVANNI). (1) The monthly climatology of sea surface chl a will be calculated from monthly remote sensing data; (2) Temporal variation of area averaged chl a and SST for selected regions (i.e. Albemarle Sound, Chesapeake Bay) will also be calculated; (3) Temporal variations of both chl a and SST distribution animation will also be created.

Younger Dryas Impact Study [2]

The events precipitating the dramatic, millennial long climatic cooling known as the Younger Dryas, that occurred approximately 13,000 years ago remain a mystery. Recent evidence suggests an extraterrestrial impact on the Laurentide ice sheet may have provided the trigger for a massive influx of fresh glacial melt water theorized to have flooded the North Atlantic and shut down the Thermohaline circulation that moderates climate in the northern hemisphere. The apparent absence of an easily identified impact crater has focused the search for evidence of an impact on a search for extraterrestrial markers embedded in the Earth's sedimentary record.

Designing and Developing a Portal for the Polar Grid High Performance Computing System at Elizabeth City State University [3]

Polar Grid is a National Science Foundation (NSF) Major Research Instrumentation (MRI) program funded partnership of Indiana University (IU) and Elizabeth City State University (ECSU) to acquire and deploy the computing infrastructure needed to investigate the urgent problems in glacial melting. The grid will be comprised of ruggedized laptops and computer clusters deployed in the field in the Polar Regions and two large scale computing clusters for detailed analysis in the U.S. – one to be installed at IU, and the other at ECSU. This installation will give ECSU a 5 Teraflop MSI High performance computing system, building on its distance education and undergraduate laboratory infrastructure to create tremendous outreach capabilities.

Accessing this computing cluster will entail the development of a grid portal to provide security, access to data, and the ability to process data along with education and outreach functions.

Development of this portal will start with the documentation of terms, processes and software needed to develop a portal and understand what the grid is. The project will then progress to producing XML page structures to display processed data acquired during expeditions in Greenland and Antarctica. Another aspect will be the development of "iGoogle Gadgets" simulating the portal user environment and the process of converting that gadget into an RSS feed.

Association of an impact with coincident reduction in the numbers of megafauna species and human population of North America has suggested a strategy for the search for evidence of the impact. If an impact is responsible for initiating the onset of the Younger Dryas, the ultimate disappearance of megafauna species and the decline in human population, then the evidence should lie at the sedimentary boundary (YDB) separating the Younger Dryas from the preceding Bolling-Allerod at a depth corresponding to 12,900 years before present.

Some of these evidential markers (magnetic grains and spherules, charcoal, and glass-like carbon) were relatively easy to extract and identify while others (nanodiamonds and fullerenes) required great care, expensive instrumentation and considerable training. Fortunately, the vessels (carbon spherules) containing the more challenging markers were identified and extracted during the soil processing for magnetic spherules and charcoal. The research project also included an investigation of local paleo-lake depressions known to harbor impact markers and whose stratigraphy could have revealed a clearer understanding of the processes that shaped the coastal topography during the Younger Dryas. The research was carried out using a combination of Ground Penetrating RADAR (GPR) and sample coring to probe the subsurface deposits of selected depressions.

The Modeling of Beach Erosion and Shoreline Changes Supported by Prior Research Based on Video Image Processing in Duck, North Carolina [4]

Climate change has affected the North Carolina coastal environments and coastal hazards have already taken place in the area. Significant adverse impacts in the form of frequent storms and higher rates of beach erosion have been registered, thus, making compelling the necessity of a current understanding of the vulnerability of coastal zones. We propose to study this vulnerability in Duck, North Carolina (location: Lat 36 10 57" N Long 75 45 05" W) utilizing the work of the Army Corps of Engineers at Duck, North Carolina at the Field Research Facility (FRF). Our interest in their work lies on the use of video imagery based techniques (researched, designed, experimented and developed by the Coastal Imaging Lab of Oregon State University) implemented for the capture and understanding of changes of near shore morphology since beaches are continuously changing from geological materials (sands, dead and/or bleached corals...etc) shifted by waves, tides, and currents moving sediments and eroding shorelines; this phenomenon carries very challenging, above all devastating outcomes on coastal communities. We are most interested in the intolerant and dramatic periods of storms and hurricanes (when sediment transport is more energetic [Stockdon and Holman, 2000] and shoreline changes are more rapid) associated with extended could cover when satellite fails to produce images of events occurring during those times.

IMPACT/APPLICATION

A total of 86 students have participated in the URE programs including 28 institutions and 12 majors. Included among the institutions were The University of Hawaii, The University of Maryland-College Park, Dillard University, Morgan State University, The University of North Carolina at Pembroke, Johnson C. Smith University, Hampton University, South Carolina State University, North Carolina A&T State University, Norfolk State University, Saint Augustine's College, NOVA University and Bethune-Cookman College. Among the majors included were Physics, Computer Science, Marine Biology, Computer Engineering, Geography, Geology, Mathematics, and Agricultural Sciences. There have been a total of 48 males and 38 females including three Hispanic, two Native American Indian, and two non-minorities participating in the program. The largest percentages of participants were African-American.

In addition to increasing the participation of underrepresented groups in ocean/marine science, another impact of the program was involving students in research who might not otherwise have the opportunity. Therefore, the URE in Ocean/Marine Science Program had an impact on students from institutions where research programs and opportunities are limited. A significant number of student

participants came from outside Elizabeth City State University. One African student from Nigeria participated in the 2008 summer program.

A dissertation study [5] which documents the impact of this project and the academic year program was completed in 2005. This study found that the program had a higher undergraduate attainment and graduate school attendance rates than both the historical department and institutional rates. 915 OF PROGRAM ALUMNI THAT ATTENDED GRADUATE SCHOOL HAVE EARNED THEIR GRADUATE DEGREES. Research opportunities were the leading component as a program benefit.

RELATED PROJECTS

NSF - CI-TEAM OCI-0636361

CRISIS - NSF FY 2005-108CM1

URE in Ocean and Marine Science ONR Grant #N0014-11-0529

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HONORS/AWARDS/ PRIZES

NSF President’s Award for Excellence in Science, Mathematics, Engineering Mentoring 2003
Emerald Award for Educational Leadership by U.S. Black Engineer Magazine 2003